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BUILDING ENERGY SIMULATION USERNEWS

For Users of EnergyPlus, SPARK, DOE-2, BLAST, Genopt, Building Design Advisor, ENERGY-10 and their Derivatives

What's Inside ?

Join the EnergyPlus User Group

The developers of EnergyPlus have formed a support group to foster discussion and maintain an archive of information for program Users.
We invite questions about program usage and suggestions for improvement to the code. Go to **groups.yahoo.com/group/EnergyPlus_Support/**

SPARK is an equation-based simulation environment that allows you to build customized models of complex physical processes by connecting calculation objects that represent system components like walls, fans, heat exchangers, chillers, ducts, mixing boxes, controls, etc. It is aimed at the simulation of innovative and/or complex building systems that are beyond the scope of whole-building programs like DOE-2 and EnergyPlus. VisualSPARK adds a graphical user interface to SPARK to simplify use of the program.

VisualSPARK 1.0.2 Released!

VisualSPARK 1.0.2 may be downloaded free of charge from

http://SimulationResearch.lbl.gov > VisualSPARK

New Features

Sparse linear solution technique

- Added sparse linear solution method based on the C library *umfpack* (http://www.cise.ufl.edu/research/sparse/umfpack) v3.2 by Tim Davis. This new solution method is selected by specifying the value 4 for the key `MatrixSolvingMethod` in the problem.prf file. It does not rely on vendor-specific BLAS routines but instead on vanilla C code, thus ensuring portability of the *SPARK* program.
- Significant gains in calculation speed by many orders of magnitude have been observed on large problems for which the Jacobian matrix is typically more than 90% sparse.

Automatic Jacobian refresh strategy

- Added value 0 as a possible choice for the `TrueJacobianEvalStep` key in the problem.prf file. The value 0 indicates that the Jacobian matrix will be refreshed automatically by the solver code whenever it is needed to ensure robust and fast convergence. The refresh strategy is based on the convergence behavior of the weighted residual norm and of the increment norm between successive iterations.
- For values larger than zero, the key `TrueJacobianEvalStep` still specifies the iteration frequency at which the Jacobian should be reevaluated.

Statistics log file

- At the end of the simulation, *solver* generates a log file with performance statistics about the solver operation. In particular, you can find information on:
  - the preference settings used for the simulation for each strong component;
  - the average sparsity of the Jacobian matrix and the number of times it has been refreshed; and the operation of both the linear solver and the nonlinear solver with average calculation times. This information can be used to compare the computational efficiency of solving models with different formulations or different preference settings.

Full affine invariant scaling scheme

- Replaced previous scaling schemes with a single scaling scheme that achieves fully affine invariant scaling in both the variable space and the residual space. This makes *solver* less sensitive to changes in the variable units and to formulations where the variables show very different orders of magnitude.
- If convergence difficulties are encountered with a particular problem, the full scaling scheme should be selected in the problem.prf file to improve the numerical behavior of *solver*.

Absolute tolerance property for each problem variable

- A new variable property, `ATOL`, was added to the *SPARK* language on the `PROBE`, `PORT` and `LINK` statements in order to specify the absolute tolerance for each problem variable. The `ATOL` property should be set to the absolute value at which the variable in question is essentially insignificant.
- In *solver*, added support to load the `ATOL` property for each problem variable, thus replacing the `AbsTolerance` keyword previously specified in the problem.prf file at the component level.
- Improved the input handler to allow it to read in properties of problem variables along with the variable values at the specified time stamps. The syntax to specify the property `ATOL` of the variable `X` is the qualified name `X:ATOL`. The input handler can read in values for any variable properties, namely `MIN`, `MAX`, `ATOL` and `INIT`.

Problem driver API

- The problem driver application programming interface (API) added to *VisualSPARK* 1.0.2 allows an advanced user to:
  - customize the sequence of operations to re-solve the same problem,
  - manage and solve multiple problems,
  - retrieve solution values and specify new inputs for a new simulation of the same problem, and
  - change runtime parameters (e.g., to perform sensitivity analysis).
- We have also modified the main.cpp file that implements the main *SPARK* driver function to use the new set of API. Comprehensive documentation on how to write such a problem driver function is available at http://simulationresearch.lbl.gov > VisualSPARK.

Default preferences in setupcpp

- Added support for default values for the component preferences specified in a file called default.prf and residing in the working directory. The default values are used to populate the template preference file associated with the solution sequence generated by *setupcpp* for the problem.
- If the file exists upon calling *setupcpp*, the values in the file are used in place of the hard-coded default preference settings. If no such file exists, then *setupcpp* will generate a template file with the hard-coded default preferences for possible future modification by the user.

Changes

Documentation

- Merged glossary of terms between the *SPARK Reference Manual* and the *VisualSPARK Users Guide*.
- Enforced text conventions throughout the documentation to better distinguish the different elements of the *SPARK* language.

Parser

- Discontinued usage of the keyword `UPDATE_FROM_LINK` in `LINK`, `PORT` and `PROBE` statements and replaced it with the keyword `INPUT_FROM_LINK` that better reflects its behavior

Solver

Improved convergence strategy

- In order to ensure that badly-scaled systems are solved with satisfactorily precision, we now force the convergence check in the non-linear solver to occur in the variable space, i.e. solely based on the increments value, after the first iteration. This represents a change from *VisualSPARK* 1.0.1 where a successful residual check carried out even after the first iteration was a sufficient condition to stop the iteration. The convergence test is stricter and more robust, especially for problems with variables with very different order of magnitudes.

Variable scales based on individual absolute tolerances

- The introduction of the `ATOL` property in the *SPARK* language allows to consider an individual absolute tolerance for each problem variable, as opposed to for each strong component as in *VisualSPARK* 1.0.1. The convergence check in the nonlinear solver and the computation of the cost function used with the backtracking Newton schemes have been updated to support the new absolute tolerance mechanism.

Graphical User Interface

- Changed default wall clock settings to year 2002
- Changed title of button from "MODIFY" to "MODIFY CLASS PATH"
- Added support for new solver features in the component preferences editor
- The absolute tolerance entry has been removed from the component preferences editor because it is now specified on a variable-by variable basis.
- Added the sparse LU matrix solving method in the component preferences editor.
- Reduced scaling types to "None" and "Full" in place of the former scaling options in *VisualSPARK* 1.0.1.

Bug Fixes

Documentation

- Corrected typo in description of the macro links where the single quote `'` used to prefix an object name in a hierarchy of objects was replaced with the single quote `` ` `` as prescribed by the *SPARK* syntax.

  `obj1'obj2'obj3~linkname`

  has been replaced with

  `obj1`obj2`obj3~linkname`
- SPARK documentation may now be downloaded as pdf files; right-click on links below or go to http://SimulationResearch.lbl.gov > VisualSPARK.

  SPARK Reference Manual, VisualSPARK Users Guide, SPARK Library Functions, SPARK Problem Driver API.

Parser

- Fixed a bug in the `PARAMETER` keyword (did not work when there was more than one `PARAMETER` statement in one class).
- Fixed infinite loop bug caused by aliased variables. Aliased variables are created in `LINK` statements that do NOT contain **`obj.port`** connections.

Setupcpp

- Write out error message showing the calling syntax if *setupcpp* is executed with no argument at the command-line instead of crashing.

Solver

- Fixed bug in *sparksym* for the *mathomatic* symbolic solver that limited to 14 the number of variables allowed in the equation to be processed.

SPARK was developed by the Simulation Research Group of Lawrence Berkeley National Laboratory and by Ayres Sowell Associates, with support from the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technology Programs of the U.S. Department of Energy, program manager Dru Crawley.

VisualSPARK 1.0.2 may be downloaded free of charge from

http://SimulationResearch.lbl.gov > VisualSPARK

EnergyPlus Version 1.0.2

To download a free copy of the program go to

www.energyplus.gov

International Weather Data for EnergyPlus

One of the most common questions asked of the EnergyPlus Development Team is *'where can I get weather data for my location?'* In the US and Canada, there are good-quality, free, public-domain data (TMY2 and CWEC). For other locations, it's a bit tougher. ASHRAE (TC 4.2 Weather Information) sponsored development of IWEC (International Weather for Energy Calculations) data for 227 locations in more than 70 countries outside the US and Canada. In your country, the local meteorological office often has better and more complete data than is available through the World Meteorological Organization (and in the US, the National Climatic Data Center, where ASHRAE obtained the source hourly data for the IWEC). If there wasn't enough good quality data available, there is no location in the IWEC.

Below is the list of international locations (IWEC) that will be available (again) soon from ASHRAE. We have licensed the data for EnergyPlus users at no cost. We will place the new IWEC data on our web site (www.energyplus.gov) as soon as it becomes available. If you have data for locations that are not listed below and would be willing to share the data with other EnergyPlus users, please contact Dru Crawley (Drury.Crawley@ee.doe.gov).

INTERNATIONAL WEATHER FOR ENERGY CALCULATIONS (IWEC WEATHER FILES)
Station_name,Country,Time Zone,Latitude (deg min),Longitude (deg min),Elevation (m)

Algeria	ALGIERS,DZA,+ 01 00,N 36 43,E 003 15,25
Australia	
BUENOS AIRES,ARG,- 03 00,S 34 49,W 058 32,20	LEARMONTH,AUS,+ 08 00,S 22 14,E 114 05,6
ADELAIDE,AUS,+ 09 30,S 34 56,E 138 31,4	MELBOURNE,AUS,+ 10 00,S 37 40,E 144 50,141
BRISBANE,AUS,+ 10 00,S 27 23,E 153 06,5	PERTH,AUS,+ 08 00,S 31 56,E 115 57,29
CANBERRA,AUS,+ 10 00,S 35 18,E 149 11,577	PORT HEDLAND,AUS,+ 08 00,S 20 14,E 119 06,8
DARWIN,AUS,+ 09 30,S 12 24,E 130 52,30	SYDNEY,AUS,+ 10 00,S 33 57,E 151 11,3
Austria	
GRAZ,AUT,+ 01 00,N 47 00,E 015 26,347	SALZBURG,AUT,+ 01 00,N 47 48,E 013 00,450
INNSBRUCK,AUT,+ 01 00,N 47 16,E 011 21,593	VIENNA SCHWECHAT,AUT,+ 01 00,N 48 07,E 016 34,190
LINZ,AUT,+ 01 00,N 48 14,E 014 12,313	
Belarus	MINSK,BLR,+ 02 00,N 53 52,E 027 32,234
Belgium	
BRUSSELS,BEL,+ 01 00,N 50 54,E 004 32,58	SAINT HUBERT,BEL,+ 01 00,N 50 02,E 005 24,557
OOSTENDE,BEL,+ 01 00,N 51 12,E 002 52,5	
Bolivia	LA PAZ,BOL,- 04 00,S 16 31,W 068 11,4042
Bosnia and Herzegovina	BANJA LUKA,BIH,+ 01 00,N 44 47,E 017 13,156
Brazil	
BELEM,BRA,- 03 00,S 01 23,W 048 29,16	SAO PAULO,BRA,- 03 00,S 23 37,W 046 39,803
BRASILIA,BRA,- 03 00,S 15 52,W 047 56,1061	BANDAR SERI BEGAWAN,BRN,+ 08 00,N 04 56,E 114 56,15
RECIFE,BRA,- 03 00,S 08 06,W 034 53,19	
Bulgaria	
PLOVDIV,BGR,+ 02 00,N 42 08,E 024 45,185	VARNA,BGR,+ 02 00,N 43 12,E 027 55,43
SOFIA,BGR,+ 02 00,N 42 44,E 023 23,595	
Chile	
ANTOFAGASTA,CHL,- 04 00,S 23 26,W 070 26,120	PUNTA ARENAS,CHL,- 04 00,S 53 00,W 070 51,37
CONCEPCION,CHL,- 04 00,S 36 46,W 073 03,16	SANTIAGO,CHL,- 04 00,S 33 23,W 070 47,476
EASTER ISLAND,CHL,- 06 00,S 27 09,W 109 25,47	

Continued …

INTERNATIONAL WEATHER FOR ENERGY CALCULATIONS (IWEC WEATHER FILES)
Station_name,Country,Time Zone,Latitude (deg min),Longitude (deg min),Elevation (m)

China	
BEIJING,CHN,+ 08 00,N 39 48,E 116 28,32	LANZHOU,CHN,+ 08 00,N 36 03,E 103 53,1518
GUANGZHOU,CHN,+ 08 00,N 23 08,E 113 19,8	SHANGHAI,CHN,+ 08 00,N 31 10,E 121 26,7
HARBIN,CHN,+ 08 00,N 45 43,E 126 41,143	SHENYANG,CHN,+ 08 00,N 41 47,E 123 29,43
KUNMING,CHN,+ 08 00,N 25 01,E 102 41,1892	URUMQI,CHN,+ 08 00,N 43 50,E 087 32,786
Colombia	BOGOTA,COL,- 05 00,N 04 42,W 074 08,2548
Cuba	HAVANA,CUB,- 05 00,N 22 59,W 082 24,59
Cyprus	LARNACA,CYP,+ 02 00,N 34 53,E 033 38,2
Czech Republic	
OSTRAVA,CZE,+ 01 00,N 49 43,E 018 11,256	PRAGUE,CZE,+ 01 00,N 50 06,E 014 17,366
Denmark	COPENHAGEN,DNK,+ 01 00,N 55 38,E 012 40,5
Ecuador	QUITO,ECU,- 05 00,S 00 09,W 078 29,2812
Egypt	
ASWAN,EGY,+ 02 00,N 23 58,E 032 47,194	CAIRO,EGY,+ 02 00,N 30 08,E 031 24,74
Fiji	NADI,FJI,+ 12 00,S 17 45,E 177 27,18
Finland	
HELSINKI,FIN,+ 02 00,N 60 19,E 024 58,56	TAMPERE,FIN,+ 02 00,N 61 25,E 023 35,112
France	
BORDEAUX,FRA,+ 01 00,N 44 50,W 000 42,61	MONTPELLIER,FRA,+ 01 00,N 43 35,E 003 58,6
BREST,FRA,+ 01 00,N 48 27,W 004 25,103	NANCY,FRA,+ 01 00,N 48 41,E 006 13,217
CLERMONT-FERRAND,FRA,+ 01 00,N 45 47,E 003 10,330	NANTES,FRA,+ 01 00,N 47 10,W 001 36,27
DIJON,FRA,+ 01 00,N 47 16,E 005 05,227	NICE,FRA,+ 01 00,N 43 39,E 007 12,10
LYON,FRA,+ 01 00,N 45 44,E 005 05,240	PARIS ORLY,FRA,+ 01 00,N 48 44,E 002 24,96
MARSEILLE,FRA,+ 01 00,N 43 27,E 005 14,36	STRASBOURG,FRA,+ 01 00,N 48 33,E 007 38,154
Germany	
BERLIN,DEU,+ 01 00,N 52 28,E 013 24,49	KOLN,DEU,+ 01 00,N 50 52,E 007 10,99
BREMEN,DEU,+ 01 00,N 53 03,E 008 48,5	MANNHEIM,DEU,+ 01 00,N 49 31,E 008 33,100
DUSSELDORF,DEU,+ 01 00,N 51 17,E 006 47,44	MUNICH,DEU,+ 01 00,N 48 08,E 011 42,529
FRANKFURT AM MAIN,DEU,+ 01 00,N 50 03,E 008 36,113	STUTTGART,DEU,+ 01 00,N 48 41,E 009 13,419
HAMBURG,DEU,+ 01 00,N 53 38,E 010 00,16	
Great Britain	
ABERDEEN/DYCE,GBR,+ 00 00,N 57 12,W 002 13,65	HEMSBY,GBR,+ 00 00,N 52 41,E 001 41,14
AUGHTON,GBR,+ 00 00,N 53 33,W 002 55,56	JERSEY/CHANNEL ISLANDS,GBR,+ 00 00,N 49 13,W 002 12,84
BELFAST,GBR,+ 00 00,N 54 39,W 006 13,81	LEUCHARS,GBR,+ 00 00,N 56 23,W 002 52,12
BIRMINGHAM,GBR,+ 00 00,N 52 27,W 001 44,99	LONDON/GATWICK,GBR,+ 00 00,N 51 09,W 000 11,62
FINNINGLEY,GBR,+ 00 00,N 53 29,W 001 00,17	OBAN,GBR,+ 00 00,N 56 25,W 005 28,4
Greece	
ANDRAVIDA,GRC,+ 02 00,N 37 55,E 021 17,12	THESSALONIKI,GRC,+ 02 00,N 40 31,E 022 58,4
ATHENS,GRC,+ 02 00,N 37 54,E 023 44,15	
Hungary	
DEBRECEN,HUN,+ 01 00,N 47 29,E 021 38,112	SZOMBATHELY,HUN,+ 01 00,N 47 16,E 016 38,221
Iceland	REYKJAVIK,ISL,+ 00 00,N 64 08,W 021 54,61
India	
AHMADABAD,IND,+ 05 30,N 23 04,E 072 38,55	MADRAS,IND,+ 05 30,N 13 00,E 080 11,16
BOMBAY,IND,+ 05 30,N 19 07,E 072 51,14	NAGPUR,IND,+ 05 30,N 21 06,E 079 03,310
CALCUTTA,IND,+ 05 30,N 22 39,E 088 27,6	NEW DELHI,IND,+ 05 30,N 28 35,E 077 12,216
GOA/PANAJI,IND,+ 05 30,N 15 29,E 073 49,60	TRIVANDRUM,IND,+ 05 30,N 08 29,E 076 57,64
Ireland	
BELMULLET,IRL,+ 00 00,N 54 14,W 010 00,10	KILKENNY,IRL,+ 00 00,N 52 40,W 007 16,64
BIRR,IRL,+ 00 00,N 53 05,W 007 53,72	MALIN,IRL,+ 00 00,N 55 22,W 007 20,25
CLONES,IRL,+ 00 00,N 54 11,W 007 14,89	VALENTIA OBSERVATORY,IRL,+ 00 00,N 51 56,W 010 15,14
DUBLIN,IRL,+ 00 00,N 53 26,W 006 15,85	
Israel	JERUSALEM,ISR,+ 02 00,N 31 47,E 035 13,782

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INTERNATIONAL WEATHER FOR ENERGY CALCULATIONS (IWEC WEATHER FILES)
Station_name,Country,Time Zone,Latitude (deg min),Longitude (deg min),Elevation (m)

Italy	
BRINDISI,ITA,+ 01 00,N 40 39,E 017 57,10	PALERMO,ITA,+ 01 00,N 38 11,E 013 06,34
GENOVA,ITA,+ 01 00,N 44 25,E 008 51,3	PISA,ITA,+ 01 00,N 43 41,E 010 23,1
MESSINA,ITA,+ 01 00,N 38 12,E 015 33,51	ROME,ITA,+ 01 00,N 41 48,E 012 14,3
MILAN,ITA,+ 01 00,N 45 37,E 008 44,211	TORINO,ITA,+ 01 00,N 45 13,E 007 39,287
NAPLES,ITA,+ 01 00,N 40 51,E 014 18,72	VENICE,ITA,+ 01 00,N 45 30,E 012 20,6
Japan	
KAGOSHIMA,JPN,+ 09 00,N 31 34,E 130 33,5	SAPPORO,JPN,+ 09 00,N 43 03,E 141 20,19
MATSUMOTO,JPN,+ 09 00,N 36 15,E 137 58,611	SHIMONOSEKI,JPN,+ 09 00,N 33 57,E 130 56,19
MIHO (CIV/JASDF),JPN,+ 09 00,N 35 29,E 133 15,9	TOKYO HYAKURI,JPN,+ 09 00,N 36 11,E 140 25,35
NAGOYA,JPN,+ 09 00,N 35 15,E 136 56,17	TOSASHIMIZU,JPN,+ 09 00,N 32 43,E 133 01,33
OSAKA,JPN,+ 09 00,N 34 47,E 135 27,15	
Kazakstan	SEMIPALATINSK,KAZ,+ 06 00,N 50 21,E 080 15,196
Kenya	NAIROBI,KEN,+ 03 00,S 01 19,E 036 55,1624
Korea (North)	
CH'ONGJIN,PRK,+ 09 00,N 41 47,E 129 49,43	P'YONGYANG,PRK,+ 09 00,N 39 02,E 125 47,38
HAEJU,PRK,+ 09 00,N 38 02,E 125 42,81	
Korea (South)	
INCH'ON,KOR,+ 09 00,N 37 29,E 126 33,70	KWANGJU,KOR,+ 09 00,N 35 08,E 126 55,72
KANGNUNG,KOR,+ 09 00,N 37 45,E 128 54,27	ULSAN,KOR,+ 09 00,N 35 33,E 129 19,33
Libya	TRIPOLI,LBY,+ 02 00,N 32 40,E 013 09,81
Lithuania	KAUNAS,LTU,+ 02 00,N 54 53,E 023 53,75
Macau	MACAU,MAC,+ 08 00,N 22 12,E 113 32,86
Madagascar	ANTANANARIVO,MDG,+ 03 00,S 18 48,E 047 29,1276
Malaysia	
GEORGE TOWN,MYS,+ 08 00,N 05 18,E 100 16,4	KUALA LUMPUR,MYS,+ 08 00,N 03 07,E 101 33,22
KOTA BAHARU,MYS,+ 08 00,N 06 10,E 102 17,5	KUCHING,MYS,+ 08 00,N 01 29,E 110 20,27
Martinique	FORT-DE-FRANCE,MTQ,- 04 00,N 14 36,W 061 00,4
Mexico	
ACAPULCO,MEX,- 06 00,N 16 46,W 099 45,5	VERACRUZ,MEX,- 06 00,N 19 12,W 096 08,14
MEXICO CITY,MEX,- 06 00,N 19 26,W 099 05,2234	
Mongolia	
ULAANBATAAR,MNG,+ 08 00,N 47 56,E 106 59,1316	ULAANGOM,MNG,+ 08 00,N 49 53,E 092 05,936
Morocco	CASABLANCA/NOUASSER,MAR,+ 00 00,N 33 22,W 007 35,206
Netherlands	
AMSTERDAM,NLD,+ 01 00,N 52 18,E 004 46,-2	GRONINGEN,NLD,+ 01 00,N 53 08,E 006 35,4
BEEK,NLD,+ 01 00,N 50 55,E 005 47,116	
New Zealand	
AUCKLAND,NZL,+ 12 00,S 37 01,E 174 48,6	WELLINGTON,NZL,+ 12 00,S 41 18,E 174 47,67
CHRISTCHURCH,NZL,+ 12 00,S 43 29,E 172 33,34	
Norway	
BERGEN,NOR,+ 01 00,N 60 18,E 005 13,50	OSLO/FORNEBU,NOR,+ 01 00,N 59 54,E 010 37,17
Pakistan	KARACHI,PAK,+ 05 00,N 24 54,E 067 08,22
Paraguay	ASUNCION,PRY,- 04 00,S 25 15,W 057 34,101
Peru	
AREQUIPA,PER,- 05 00,S 16 19,W 071 33,2520	LIMA,PER,- 05 00,S 12 00,W 077 07,13
CUZCO,PER,- 05 00,S 13 33,W 071 59,3249	
Philippines	MANILA,PHL,+ 08 00,N 14 31,E 121 00,21
Poland	
KOLOBRZEG,POL,+ 01 00,N 54 11,E 015 35,5	POZNAN,POL,+ 01 00,N 52 25,E 016 50,92
KRAKOW,POL,+ 01 00,N 50 05,E 019 48,237	WARSAW,POL,+ 01 00,N 52 10,E 020 58,107
Portugal	
BRAGANCA,PRT,+ 00 00,N 41 48,W 006 44,692	FARO,PRT,+ 00 00,N 37 01,W 007 58,4
COIMBRA,PRT,+ 00 00,N 40 12,W 008 25,140	LAJES,PRT,- 01 00,N 38 46,W 027 06,55
EVORA,PRT,+ 00 00,N 38 34,W 007 54,321	PORTO,PRT,+ 00 00,N 41 14,W 008 41,73

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INTERNATIONAL WEATHER FOR ENERGY CALCULATIONS (IWEC WEATHER FILES)
Station_name,Country,Time Zone,Latitude (deg min),Longitude (deg min),Elevation (m)

Romania	
BUCHAREST,ROM,+ 02 00,N 44 30,E 026 08,91	CRAIOVA,ROM,+ 02 00,N 44 14,E 023 52,195
CLUJ-NAPOCA,ROM,+ 02 00,N 46 47,E 023 34,413	GALATI,ROM,+ 02 00,N 45 30,E 028 01,72
CONSTANTA,ROM,+ 02 00,N 44 13,E 028 38,14	TIMISOARA,ROM,+ 02 00,N 45 46,E 021 15,88
Russia	
ARKHANGEL'SK,RUS,+ 04 00,N 64 32,E 040 28,13	OMSK,RUS,+ 06 00,N 54 56,E 073 24,123
CHITA,RUS,+ 09 00,N 52 01,E 113 20,685	SAINT-PETERSBURG,RUS,+ 03 00,N 59 58,E 030 18,4
EKATERINBURG,RUS,+ 05 00,N 56 48,E 060 38,237	SAMARA,RUS,+ 04 00,N 53 15,E 050 27,44
IRKUTSK,RUS,+ 08 00,N 52 16,E 104 21,513	YAKUTSK,RUS,+ 09 00,N 62 05,E 129 45,103
MOSCOW,RUS,+ 03 00,N 55 45,E 037 38,156	
Saudi Arabia	RIYADH,SAU,+ 03 00,N 24 42,E 046 48,612
Senegal	DAKAR,SEN,+ 00 00,N 14 44,W 017 30,24
Singapore	SINGAPORE,SGP,+ 08 00,N 01 22,E 103 59,16
Slovakia	
BRATISLAVA,SVK,+ 01 00,N 48 12,E 017 12,130	KOSICE,SVK,+ 01 00,N 48 42,E 021 16,232
Slovenia	LJUBLJANA,SVN,+ 01 00,N 46 13,E 014 29,385
South Africa	
CAPE TOWN,ZAF,+ 02 00,S 33 59,E 018 36,42	
JOHANNESBURG,ZAF,+ 02 00,S 26 08,E 028 14,1700	
Spain	
BARCELONA,ESP,+ 01 00,N 41 17,E 002 04,6	SANTANDER,ESP,+ 01 00,N 43 28,W 003 49,40
MADRID,ESP,+ 01 00,N 40 27,W 003 33,582	SEVILLA,ESP,+ 01 00,N 37 25,W 005 54,31
PALMA,ESP,+ 01 00,N 39 33,E 002 44,8	VALENCIA,ESP,+ 01 00,N 39 30,W 000 28,62
Sweden	
GOTEBORG LANDVETTER,SWE,+ 01 00,N 57 40,E 012 18,169	OSTERSUND/FROSON,SWE,+ 01 00,N 63 11,E 014 30,370
KARLSTAD,SWE,+ 01 00,N 59 22,E 013 28,55	STOCKHOLM ARLANDA,SWE,+ 01 00,N 59 39,E 017 57,61
KIRUNA,SWE,+ 01 00,N 67 49,E 020 20,452	
Switzerland	GENEVA,CHE,+ 01 00,N 46 15,E 006 08,416
Syria	DAMASCUS,SYR,+ 02 00,N 33 25,E 036 31,605
Taiwan	TAIPEI,TWN,+ 08 00,N 25 04,E 121 33,6
Thailand	BANGKOK,THA,+ 07 00,N 13 55,E 100 36,12
Tunisia	TUNIS,TUN,+ 01 00,N 36 50,E 010 14,4
Turkey	
ANKARA,TUR,+ 02 00,N 40 07,E 032 59,949	IZMIR,TUR,+ 02 00,N 38 30,E 027 01,5
ISTANBUL,TUR,+ 02 00,N 40 58,E 028 49,37	
Ukraine	
KIEV,UKR,+ 02 00,N 50 24,E 030 27,168	ODESSA,UKR,+ 02 00,N 46 27,E 030 42,35
United Arab Emirates	ABU DHABI,ARE,+ 04 00,N 24 26,E 054 39,27
Uruguay	MONTEVIDEO,URY,- 03 00,S 34 50,W 056 00,32
Uzbekistan	TASHKENT,UZB,+ 05 00,N 41 16,E 069 16,458
Venezuela	CARACAS,VEN,- 04 00,N 10 36,W 066 59,48
Vietnam	HANOI,VNM,+ 07 00,N 21 01,E 105 48,6
Yugoslavia	
BELGRADE,YUG,+ 01 00,N 44 49,E 020 17,99	PODGORICA,YUG,+ 01 00,N 42 22,E 019 15,33
Zimbabwe	HARARE,ZWE,+ 02 00,S 17 55,E 031 08,1503

If you want to know more about weather data in EnergyPlus and how to use the WeatherConverter, go to the DocMainMenu (under Start, Programs, EnergyPlus Programs) and click on Auxiliary Programs and Developer Guides. Then click on Auxiliary Program Information. The Weather Converter is discussed beginning on page 16.

Thanks, **EnergyPlus Development Team**

EnergyPlus is being developed by University of Illinois, CERL, and Lawrence Berkeley National Laboratory, with the assistance of the Florida Solar Energy Center, GARD Analytics, the University of Wisconsin, Oklahoma State University and others. Development of EnergyPlus is supported by the U. S. Department of Energy, Dru Crawley, Program Manager.

Ask An EnergyPlus Expert

Question:

Does EnergyPlus support heating or cooling systems other than air conditioning systems? I am thinking of water systems like underfloor heating, active wall/ceiling systems and radiator systems.

Answer:

Yes, it can do all of these. In addition to forced air systems using DX and chilled water cooling, EnergyPlus can model hot water radiators (BASEBOARD HEATER:Water:Convective), heated and cooled surfaces (LOW TEMP RADIANT SYSTEM:HYDRONIC, LOW TEMP RADIANT SYSTEM:ELECTRIC) and gas or electric radiant heaters (HIGH TEMP RADIANT SYSTEM).

Question:

I noticed in the EnergyPlus Input/Output Reference Manual that Fig. 5 (p. 60) does not show blinds consisting of slats. Further the verbal description of slat details in the Manual is unclear.
My question, then, is this: What is the slat width and the slat separation?

Answer:

In the field descriptions for Material:WindowBlind, the references to Fig. 5 are incorrect; they should all be references to Fig. 6, found on p. 66. Our apologies for the confusion. Also, check out the "blinds" section of the Engineering Doc Reference under "Optical Properties of Windows". There is also an example file: PurchAirWindowBlind.idf which may illustrate the use for you.

Question:

I am having trouble getting my controls to work for a single duct VAV with reheat.
My cooling coil is producing 28F discharge air and my reheat terminals are running full reheat.

Answer:

See the VAVSingleDuctReheat.idf example in EnergyPlus\Examples\Misc to see how the cooling coil controls should be set up.

Question:

If the building's electric consumption only depends on the lighting and the electric equipment, then where do I input the chiller and chilled water pump electric consumption to effect the building total electric consumption? If i change the nominal capacity in CHILLER:ELECTRIC, the result on total building electric consumption doesn't change at all. What is the effect of CHILLER:ELECTRIC in this building simulation?

Answer:

To report the master meter for the entire building, including HVAC equipment, add the following to your input file: report meter, electricity:facility, hourly; (or monthly, or environment)
To see just the electric consumption of the chiller, add this:

report variable, *, Chiller Electric Consumption, hourly;

See the Input Output Reference, pp. 530-537 for more information.

Building Energy Software from Lawrence Berkeley National Laboratory

Free Downloads	
BDA 2.0 (Building Design Advisor) *A beta version of 3.0 is available from vpal@lbl.gov*	**gaia.lbl.gov/BDA**
COMIS (multi-zone air flow and contaminant transport model)	**www-epb.lbl.gov/comis**
***EnergyPlus* 1.0.2** (new-generation whole-building energy analysis program, based on BLAST and DOE-2)	**www.energyplus.gov** --or-- **SimulationResearch.lbl.gov > EnergyPlus**
***GenOpt*® 1.1.2** (generic optimization program)	**SimulationResearch.lbl.gov > GenOpt**
RADIANCE (analysis and visualization of lighting in design) ***Desktop Radiance*** (integrates the Radiance Synthetic Imaging System with AutoCAD Release 14)	**radsite.lbl.gov/radiance/** **radsite.lbl.gov/deskrad/**
RESEM (Retrofit Energy Savings Estimation Model) (calculates long-term energy savings directly from actual utility data)	**eetd.lbl.gov/btp/resem.htm**
SUPERLITE (calculates illuminance distribution for room geometries)	**eetd.lbl.gov/btp/superlite2.html**
THERM 2.1a (models two-dimensional heat-transfer effects in building components where thermal bridges are of concern)	**windows.lbl.gov/software/therm/therm.html**
VisualSPARK 1.0.2 (Simulation Problem Analysis and Research Kernel) (connect component models to simulate innovative building envelope and HVAC systems)	**SimulationResearch.lbl.gov > VisualSPARK**
WINDOW 5 (thermal analysis of window products)	**windows.lbl.gov/software/window/window.html**
Free Software / Request by Fax from 510.486.4089	
RESFEN 3.1 (choose energy-efficient, cost-effective windows for a given residential application)	**windows.lbl.gov/software/resfen/resfen.html**
Web Based	
Home Energy Saver (quickly computes home energy use) and ***Home Improvement Tool*** (simplified Home Energy Saver)	**hes.lbl.gov** and **hit.lbl.gov**
Purchase	
ADELINE 2.0 (daylighting performance in complex spaces)	**radsite.lbl.gov/adeline/**

California Energy Commission Webcast of Energy Code Training
January 15, 2003 - Live and OnLine
Register at http://www.energyvideos.com

BLAST*news*

www.bso.uiuc.edu

Building Systems Laboratory, 30 Mech Eng Bldg.
University of Illinois, 1206 West Green Street
Urbana, IL 61801
Tel: (217) 333-3977 - Fax: (217) 244-6534
support@blast.bso.uiuc.edu

The **Building Loads Analysis and System Thermodynamics (BLAST** program predicts energy consumption, energy system performance and cost for new or existing (pre-retrofit) buildings.

BLAST contains three major sub-programs:

- **Space Load Prediction** computes hourly space loads in a building based on weather data and user inputs detailing the building construction and operation.
- **Air Distribution System Simulation** uses the computed space loads, weather data, and user inputs.
- **Central Plant Simulation** computes monthly and annual fuel and electrical power consumption.

Heat Balance Loads Calculator (HBLC)
The BLAST graphical interface (HBLC) is a Windows-based interactive program for producing BLAST input files. You can download a demo version of HBLC (for MS Windows) from the BLAST web site (User manual included).

HBLC/BLAST Training Courses
Experience with the HBLC and the BLAST family of programs has shown that new users can benefit from a session of structured training with the software. The Building Systems Laboratory offers such training courses on an as needed basis typically at our offices in Urbana, Illinois.

WINLCCID 98
LCCID (Life Cycle Cost in Design) was developed to perform Life Cycle Cost Analyses (LCCA) for the Department of Defense and their contractors.

To order BLAST-related products, contact the Building Systems Laboratory at the address above.

Program Name	Order Number	Price
PC BLAST Includes: BLAST, HBLC, BTEXT, WIFE, CHILLER, Report Writer, Report Writer File Generator, Comfort Report program, Weather File Reporting Program, Control Profile Macros for Lotus or Symphony, and the Design Week Program. The package is on a single CD-ROM and includes soft copies of the BLAST Manual, 65 technical articles and theses related to BLAST, nearly 400 processed weather files with a browsing engine, and complete source code for BLAST, HBLC, etc. Requires an IBM PC 486/Pentium II or compatible running MS Windows 95/98/NT.	3B486E3-0898	$1500
PC BLAST Package Upgrade from level 295+	4B486E3-0898	$450
WINLCCID 98: executable version for 386/486/Pentium	3LCC3-0898	$295
WINLCCID 98: update from WINLCCID 97	4LCC3-0898	$195

The last four digits of the catalog number indicate the month and year the item was released or published. This will enable you to see if you have the most recent version. All software will be shipped on 3.5" high density floppy disks unless noted otherwise.

PG&E Fall and Winter 2002 Programs

Pacific Gas and Electric Company
WE DELIVER ENERGY.

To register call the Pacific Energy Center (at least one week in advance) 415.973.7268 or go to www.pge.com/pec

WHOLE-BUILDING PERFORMANCE

November 19 — **Life Cycle Cost Analysis**
Kevin Hydes of Keen Engineering will cover full environmental life cycle cost analysis: the balancing of environmental, social, and economic factors while understanding and acknowledging building and system efficiency, longevity, and durability.

December 05 — **Data Collection for Pumps and Fans**
This program covers the tools and techniques available to assess and implement energy saving retrofits on pump and fan systems for commercial and industrial buildings. The instructors will cover pump and fan fundamentals, site survey and project screening techniques, and field measurement equipment.

ARCHITECTURE

November 14 — **Fundamentals of Skylighting in Non-Residential Buildings**
In this program we will summarize research on the connection between daylight and productivity, provide an overview of skylighting design considerations, and direct participants to resources available to assist with skylighting design.

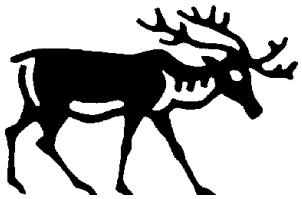
November 14 — **Advanced Skylighting Design in Non-Residential Buildings**
In case studies covering office, retail, and classroom buildings, we will review and analyze the reasoning behind design decisions. We will also cover guidelines for the development of design specifications and acceptance criteria.
Prerequisite: Fundamentals of Skylighting program held earlier in the day.

November 26 — **High Performance Schools (CHPS) Workshop**
A diverse panel of experts will discuss daylighting design and student productivity, high performance electric lighting, optimized HVAC systems, sustainable site planning and materials, and available tools for districts and their design teams.

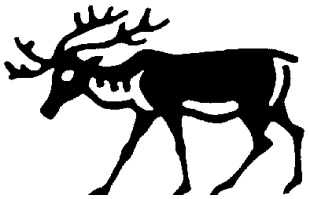
LIGHTING

November 12 — **Lighting Design for Architects**
Lighting designer Tom Tolen, LC, will focus on fundamental lighting concepts for architects, including terminology, visual perception, surface properties, light and color theory, equipment, design criteria, and applied design.

MAN CAN CURE DISEASE BUT HE CANNOT CURE FATE



DOE-2



DOE-2.1E (v. 119) 1,000-Zone version for Windows from ESTSC; other vendors of DOE-2 based programs are listed on our website: http://SimulationResearch.lbl.gov > DOE-2

Cost is as follows:

$ 300	U.S. Government, non-profit Educational
$ 575	U.S., Mexico, Canada
$ 1268	Japan only
$ 1075	All Other Non-U.S.

DOE-2 Documentation on a CD from ESTSC - Cost US$100

What is included on the CD?

- DOE-2 Reference Manual (Part 1)
- DOE-2 Reference Manual (Part 2)
- DOE-2 Supplement to the Reference Manual (2.1E)
- DOE-2 BDL Summary (2.1E)
- DOE-2 Engineers Manual (2.1A)

Order Software and ESTSC Documentation

Ed Kidd
NCI Information Systems, Inc.
Energy Science and Technology Software Center (ESTSC)
P.O. Box 1020
Oak Ridge, TN 37831

Phone: 865/576-1037
Fax: 865/576-6436
Email: estsc@adonis.osti.gov

Purchase DOE-2 Documentation

DOE-2 Sample Run Book (2.1E) -- The Sample Run book is the only remaining DOE-2 manual not available electronically. It must be purchased separately from NTIS; information is at http://SimulationResearch.lbl.gov > DOE-2 > Documentation

Free DOE-2 Documentation (http://SimulationResearch.lbl.gov > DOE-2 > Documentation)

- DOE-2 Basics (2.1E)
- Update Package #1: DOE-2.1E Basics, the Supplement and BDL Summary
- Update Package #2: (Version 107, DOE-2.1E) BDL Summary and Supplement.

DOE-2 Basics and Update Packages 1, 2, 3 and 4 are not included on the ESTSC CD. They consist of scanned pdf files and may be downloaded from our web site. You may also request the same information on a CD by sending email to klellington@lbl.gov.

The update files need to be printed and the update pages inserted into the existing DOE-2 manuals.

DOE-2 listings are continued on the next page

--Continued—

Free DOE-2 Documentation (http://SimulationResearch.lbl.gov > DOE-2 > Documentation)

- Update Package #3: Appendix A of the Supplement.
- Update Package #4: (1000-zone DOE-2.1E) BDL Summary.
- DOE-2 Modeling Tips (pdf)

Note that the Update Packages are **not** cumulative and each one contains different information. You have to download all four packages to update the DOE-2 documentation completely.

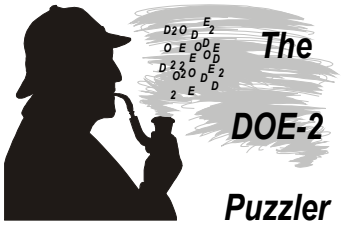
DOE-2 Modeling Tips is a compilation of all the "how to" articles from the *Building Energy Simulation User News* (through 2001).

DOE-2 Training

Private or group DOE-2 courses for beginning and advanced users:
Contact Marlin Addison at (602) 968-2040, marlin.addison@doe2.com

DOE-2 Help Desk

Email, phone or fax the Simulation Research Group with your questions (klellington@lbl.gov).
Phone: (510) 486-5711, Fax: (510) 486-4089



Question:
I've got some basic questions about DX Units. Does the DX mean direct expansion system?

Answer:
Yes, DX stands for direct expansion. Of course this means nothing by itself, but in general it means a small or medium sized system (up to say 400 kW) which uses the refrigerant evaporator to directly cool supply air. This would be in contrast to a central chiller/chilled water system in which the evaporator is used to chill water which is then pumped around the system to the various cooling coils. Most often the DX units have air-cooled condensers. The typical applications are residential room (window) air conditioners or split system air-to-air heat pumps, or commercial rooftop (packaged) units, used for modest-sized commercial buildings.

Question:
What is the typical COP for that system compared to normal chiller based system, where the COP is more than 3?

Answer:
DX systems tend to be less efficient than central chillers since they are often cheaply built and usually have air-cooled condensers. But the COP can definitely be above 3, maybe 3.4.

Question:
Is it possible to use free cooling with DX cooling?

Answer:
These units are factory built, usually of low quality; I've never heard of free cooling from a cooling tower with these units. They usually do have an outside air economizer capability. You could certainly hand-build a DX unit with free cooling.

Question:
How can it be modeled in DOE-2?

Answer:
The Packaged Variable air Volume System (PVAV) system would be the way to go.

Adapting DOE-2 to Meet the Research Interests of the Egyptian Housing Bureau and Building Research Center

by
Joe Huang (yjhuang@lbl.gov)
Simulation Research Group
Building Technologies Department
Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory

For the past two years, the author has been working with Joe Deringer of The Deringer Group in Berkeley and Prof. Moncef Krarti of the University of Colorado to provide technical assistance to the Housing Bureau of Egypt to develop building energy standards for that country (see http://www.icbec.org/EgyptHome.htm for details).

DOE-2 was recommended as the simulation tool. User training was provided both in Egypt and the U.S. Training was first done with a user-friendly version of DOE-2 (*VisualDOE* which has a graphical interface) and then migrated to a standard version of DOE-2.1E as the Housing Bureau staff gained more familiarity with the text-based input and output. To facilitate running parametric simulations, The Deringer Group developed a simple but effective Windows-based procedure called *doe2parm* (see http://www.icbec.org/Egypt/Software/DOE2Parm.htm for details).

The following two sections describe specialized applications of DOE-2 that were developed in response to the needs of the project; we hope they will be of interest to other building energy simulation professionals.

Modeling Thermal Comfort Using the DOE-2 Program

Since many residential buildings in Egypt do not have mechanical air-conditioning, the Housing Bureau wanted to know what the indoor thermal conditions were when only natural ventilation or ceiling fans were available, and what improvements could be expected if building standards were adopted.

To evaluate indoor thermal comfort conditions, a DOE-2 Function was written to derive the Predicted Percent Dissatisfied (PPD) and Predicted Mean Vote (PMV) based on the Fanger Model. The calculations in this Function followed the derivation given in a paper by one of the team members (Holz et al. 1996). The Fanger Model, like other comfort models, requires as input the Mean Radiant Temperature (MRT) of the space. DOE-2, however, usually calculates only the indoor air temperature and not the inside surface temperatures on which the MRT is based. To address this deficiency, in 1994 Markus Koschenz, a researcher from the Swiss Bureau of Standards (EMPA), added a module to DOE-2.1E that back-calculated the inside surface temperatures and then, using these figures, calculated the Mean Radiant and Effective Temperatures. This modification was described in "Calculation of Surface Temperatures in DOE-2" in Volume 20, No. 2 (Summer 1999) of the *Building Energy Simulation User News* (follow this link to an updated version of the article: http://simulationresearch.lbl.gov/dirsoft/un_articles.pdf).

One of the most problematic aspects in writing a DOE-2 Function is determining where a program variable of interest can be accessed. This problem is especially tricky when the variable, i.e., Mean Radiant Temperature, is a later addition that is calculated after the DOE-2 SYSTEM calculations for each hourly time step have been completed. Since there are no Function access points within the EMPA modifications, the only way to access the Mean Radiant and Effective Temperatures is to write them to a SYSTEMS hourly-report, and have the function loop through the HOURLY-REPORT array at the conclusion of each time step to pick up the temperatures.

Therefore, to properly run the PPMV Function shown below requires these two changes to your input:

1. The option for calculating Inside Surface Temperatures is turned on, i.e., under the BUILDING-LOCATION command, add SURF-TEMP-CALC = YES.
2. The Mean Radiant Temperature (Variable 91) and Effective Temperature (Variable 92) for each zone of interest are written to an hourly-report file. Here is a sample hourly-report input for a two-zone building:

```
HRSCH=SCHEDULE  THRU DEC 31 (ALL) (1,24) VALUES=(1)  ..
RB1=REPORT-BLOCK VARIABLE-TYPE=ZONE_1 VARIABLE-LIST=(91,92) ..
RB2=REPORT-BLOCK VARIABLE-TYPE=ZONE_2 VARIABLE-LIST=(91,92) ..
SHR=HOURLY-REPORT REPORT-SCHEDULE=HRSCH
```

```
      REPORT-BLOCK=(RB1,RB2) ..
```

Like other functions, PPMV.func should be inserted in the SYSTEMS input after the END command but before the COMPUTE SYSTEM command. If everything is set up correctly, the DOE-2 output will contain the PPD and PMV every hour for each zone, so you should be prepared for rather large output files. In addition, whenever DOE-2 is used with SURF-TEMP-CALC=YES, it generates a huge fort.15 file and a smaller fort.16 file. These should be deleted as they are temporary binary files with no further use.

If there are any questions in the use of this function, please e-mail Joe Huang at YJHuang@lbl.gov.

---------- function ppmv.func follows ----------

```
FUNCTION NAME=PPMV ..
ASSIGN MON=IMO DAY=IDAY HR=IHR
       INILZE=INILZE
       IP=IP
       NPLSYS=NPLSYS
       IPLSYS=IPLSYS
       ISZONES=ISZONES
       NZONES=NZONES
       NPL=NPL
       NSP=NSP
       ZP1=ZP1
       ZP2=ZP2
       ZP2_EDTT=ZP2--EDTT
       IZNBUFP=IZNBUFP
       NZD=NZD
       ZNAM1=ZONE-NAME
       ta=TNOW
       VNTCFM=VNTCFM
       CFMZ=CFMZ
       Wa=HUMRAT
       Patm=PATM
    $  VS=WNDSPD     using outside wind speed as interim air speed
       VS=0
       Msi=metabolic_rate[] $ W/m2 range 57-95
       Wsi=work_rate[]      $ W/m2 generally 10% of above
       IPFLAG=PPMV_print[]  $ 0=detailed, 1=hourly
       IclWIN=clo_win[]     $ fraction
       IclSUM=clo_sum[]     $ fraction
       fanon=ceilfan_stp[]  $ ceil fan on temp (C)
       acon=aircond_stp[]   $ A/C on temp (C)
       ..
CALCULATE ..
      NPL=IP
      NS=0
100   NS=NS+1
      IF (NS.GT.NPLSYS) GO TO 199
      NSP=IACCESS(IPLSYS+NS-1)
      ZP1=ISZONES
      I=0
200   I=I+1
      IF (I.GT.NZONES) GO TO 299
      ZP2=ZP2_EDTT
      IPTR=IZNBUFP-1
      TMRX=ACCESS(IPTR+91)
      WZONEX=ACCESS(IPTR+93)
C     PRINT 5,CFMZ,VNTCFM
5     FORMAT(2F10.2)
C     ZP1=ZP1+NZD
C
C   PPMV follows
C
C  set Metabolic and clothing values
C
      IF (MON.LT.5) Icl=IclWin
      IF (MON.GE.5.AND.MON.LE.9) Icl=IclSum
      IF (MON.GT.9) Icl=IClWin

C  convert units from SI to IP
      M = Msi/3.1536
      W = Wsi/3.1536
```

```
      tac = (ta-32)/1.8
      tmrc = (tmrx-32)/1.8
      pasi = 689.5*Patm

C  assume ceiling fans are used when air temperature is
C  between ceilfan (fanon) and a/c (acon) setpoints
C  and provides 0.25 m/sec (50 fpm) air motion

      VS = 0
      if (tac.gt.fanon.and.tac.le.acon) VS = 50
      vssi = VS*0.005

C  calculate (M-W) and Rcl
      MW = M - W
      Rcl = 0.88*Icl
C  convert inHg to PSI and calculate Pa
      Patmx=Patm*0.49116
      Pa = Patmx/(1.0+0.622/Wa)
C  calculate tcl
      tcl = MW - 0.97*(5.73-0.22*MW-6.9*Pa) - 0.42*(MW-18.43)
      tcl = tcl - 0.0173*M*(5.87-6.9*Pa) - 0.00077*M*(93.2-ta)
      tcl = 96.3 - 0.156*MW - Rcl*tcl
C  calculate (tcl+460)**4
      tcl4 = 4*alog(tcl+460)
      tcl4 = exp(tcl4)
C  calculate (tmrx+460)**4
      tmrx4 = 4*alog(tmrx+460)
      tmrx4 = exp(tmrx4)
C  calculate hc
      tcl_ta = 0.25*alog(abs(tcl-ta))
      tcl_ta = 0.361*exp(tcl_ta)
      if (VS.GT.0) vsqrt = 0.151*sqrt(VS)
      if (VS.EQ.0) vsqrt = 0
      if (tcl_ta.gt.vsqrt) hc = tcl_ta
      if (tcl_ta.le.vsqrt) hc = vsqrt
C  calculate fcl
      if (Icl.le.0.5) fcl = 1.0 + 0.2*Icl
      if (Icl.gt.0.5) fcl = 1.05 + 0.1*Icl
C  calculate L
      L = MW - 1.196*0.000000001*fcl*(tcl4 - tmrx4)
      L = L - fcl*hc*(tcl-ta)-0.97*(5.73-0.022*MW) - 6.9*Pa
      L = L - 0.42*(MW-18.43) - 0.0173*M*(5.87-6.9*Pa)
      L = L - 0.00077*M*(93.2-ta)
C  convert to SI
      tclc = (tcl-32)/1.8
      Lsi = L*3.1536
C  calculate PMV and PPD
      PMV = (0.303*exp(-0.036*M) + 0.028)*L
      PMV2 = PMV*PMV
      PMV4 = PMV2*PMV2
      PPD = 100 - 95*exp( -1.0*(0.03353*PMV4 + 0.2179*PMV2) )
      IF (INILZE.LT.8) RETURN
      ICOUNT = ICOUNT + 1
      IF (IPFLAG.GT.0) GO TO 205
      IF (ICOUNT.EQ.1) PRINT 1
  1   FORMAT(/13X,4HZone,4x,2HIS,1x,2HIZ,3x,2HTa,2x,3HTmr,
     +        3x,2HWa,4x,2HWS,3x,2HPa,4x,3Htcl,4x,
     +        1HL,5x,3HPMV,3x,3HPPD)
      PRINT 20,MON,DAY,HR,ACCESS(ZP2),ACCESS(ZP2+1),NS,I,
     +         tac,tmrc,Wa,vssi,pasi,tclc,Lsi,PMV,PPD
 20   FORMAT(3F4.0,1X,2A4,F3.0,F3.0,2F5.1,F6.3,F5.2,
     +       f7.0,f5.1,f7.1,f6.1,f6.1)
      GO TO 210
205   CONTINUE
      IF (IPFLAG.GT.1) GO TO 207
      IF (ICOUNT.EQ.1) PRINT 2
  2   FORMAT(/14X,4HZone,5x,2HIS,2x,2HIZ,2x,2HTa,4x,3HTmr,
     +        5x,3HPMV,3x,3HPPD)
      PRINT 22,MON,DAY,HR,ACCESS(ZP2),ACCESS(ZP2+1),NS,I,
     +         tac,tmrc,PMV,PPD
 22   FORMAT(1X,3F4.0,1X,2A4,1x,F2.0,1x,F3.0,2F6.1,f7.2,f6.1)
      GO TO 210
207   CONTINUE
```

```
C     monthly hourly print not implemented !
C     store monthly hourly values
C     data(HR) = data(HR) + PMV
210   CONTINUE
      ZP1=ZP1+NZD
      GOTO 200
299   CONTINUE
      GOTO 100
199   CONTINUE
      END
```

Modeling Domes in DOE-2

The Egyptian researchers expressed the need to model domes and vaults, which are prevalent in Egyptian architecture. In response, I wrote an awk script that generates DOE-2 BDL input lines for a dome composed of A rows, each containing A*4 quadrilateral polygons, with one flat polygon with A*4 sides on the top, and two flat roofs surrounding the base, which I call the *skirt*. A, the dome radius and the location of the dome center are specified in a small input file read by the awk script, with one line for each polygon. The input file contains the following 5 numbers: dome radius, number of rows (A), the length of the square roof, and the X and Y coordinates for the dome center. For example, Figure 1 shows the result for a dome with a radius of 5 made up of 3 rows, flat roof with a length of 15, and located at the origin (X=0, Y=0). Figure 2 shows a more detailed model of the same dome, but now made up of 7 rows.

The proper syntax to generate the DOE-2 input file lines is

awk -f dome.awk dome.dat > dome.bdl

where dome.awk is the awk file, dome.dat is the short input file, and dome.bdl is the output BDL file. Both drawings were made running the BDL files through *DrawBDL 3.0*.

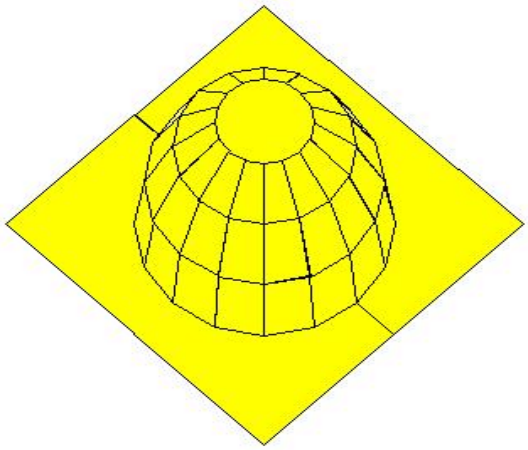


Figure 1

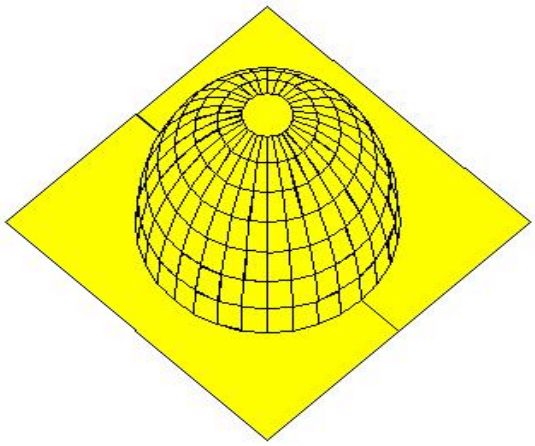


Figure 2

Listing for dome.awk ----------

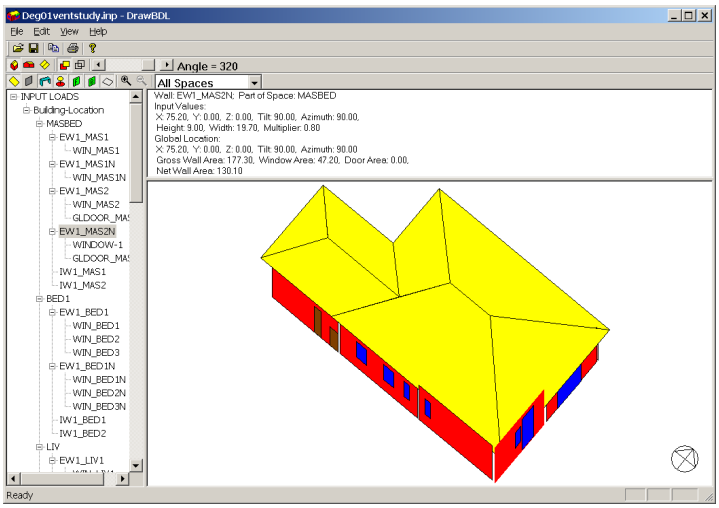
```
#
# this awk script generates DOE-2 BDL input for a dome composed of "arcs" x "rows" of quadrilateral polygons and one polygon with "arcs" sides on the
# top. Syntax is awk -f dome.awk dome.dat > dome.bdl where dome.dat is a file with 1 line per dome, each line containing 4 numbers for the dome radius,
# number of rows (integer) for dome, the length of the square roof, and the X Y coordinates at the dome center  --  Joe Huang 22 July 02

{angle = 2*3.14159263/360.}
{r = $1 ; rows = $2; rflgth = $3}
{arcs = $2*4 ; ang1 = 360/arcs ; ang2 = ang1/2 }
{if (NR==1) printf("INPUT LOADS ..\nBUILDING-LOCATION  AZ 0 ..\n") }
{printf("DOME%d SPACE X %1.2f Y %1.2f ..\n",NR,$4,$5) }
{for (i=1;i<=arcs;i++) az[i]=ang1*i - ang2 }
{rowlgth =2*r*sin(360*angle/(arcs*2) )}
{for (i=1;i<=rows;i++)
  {
   rowtilt[i] = (90+ang2)-(ang1*i)
   rowht[i] = r*sin(rowtilt[i]*angle)
   rowz[i] = r*sin((i-1)*ang1*angle)
   rowwd[i] = 2*r*sin(ang2*angle)*cos((i-1)*ang1*angle)
  }
```

```
}
{for (i=1;i<=rows;i++)
  {
   j=i+1
   rowstart[i] = (rowwd[i] + rowwd[j])/2
   rowend[i] = (rowwd[i] - rowwd[j])/2
   printf("SET-DEFAULT FOR ROOF Z %1.2f TILT %d ..\n",rowz[i],rowtilt[i])
   if (i < rows )
     {
      for (k=1;k<=arcs;k++)
        {
         rowx[i,k] = r*sin(ang1*k*angle)*cos((i-1)*ang1*angle)
         rowy[i,k] = r*cos(ang1*k*angle)*cos((i-1)*ang1*angle)
         if (k == 1)
           {
            printf("DOME%d%d-%dP     POLYGON     (0,0)     (%1.2f,0)     (%1.2f,%1.2f)     (%1.2f,%1.2f)
..\n",NR,i,k,rowwd[i],rowstart[i],rowlgth,rowend[i],rowlgth)
            printf("DOME%d%d-%d    ROOF    POLYGON    DOME%d%d-%dP    X    %1.2f    Y    %1.2f    AZ    %d
..\n",NR,i,k,NR,i,k,rowx[i,k],rowy[i,k],az[k])
           }
         else
           printf("DOME%d%d-%d    ROOF    LIKE    DOME%d%d-1    X    %1.2f    Y    %1.2f    AZ    %d
..\n",NR,i,k,NR,i,rowx[i,k],rowy[i,k],az[k])
        }
     }
   else
     {
      printf("DOME%d%d-1P POLYGON  ",NR,i)
   #  for (k=1;k<=arcs;k++)
      for (k=arcs;k>=1;k--)
        {
         rowx[i,k] = r*sin(ang1*k*angle)*cos((i-1)*ang1*angle)
         rowy[i,k] = r*cos(ang1*k*angle)*cos((i-1)*ang1*angle)
         l = k-1
         if (l%5 == 0) printf "\n  "
         printf("(%1.2f,%1.2f) ",rowx[i,k],rowy[i,k])
   #     if (k== arcs) printf " .. \n"
         if (k== 1) printf " .. \n"
        }
      printf("DOME%d%d-1 ROOF POLYGON DOME%d%d-1P X 0  Y 0  AZ 0 TILT 0 .. \n",NR,i,NR,i)
     }
  }
}
END {
printf("SKIRT-EP  POLYGON  (0,%d)  (0,%d)  (%d,%d)  (%d,%d)  (0,%d)  (0,%d)\n",-r,-rflgth/2,rflgth/2,-
rflgth/2,rflgth/2,rflgth/2,rflgth/2,r)
halfarc=arcs/2 - 1
for (k=1;k<=halfarc;k++)
  {
   rowx[1,k] = r*sin(ang1*k*angle)
   rowy[1,k] = r*cos(ang1*k*angle)
   l = k-1
   if (l%5 == 0 && k > 1) printf "\n  "
   printf("(%1.2f,%1.2f) ",rowx[1,k],rowy[1,k])
   if (k == halfarc) printf " .. \n"
  }
printf("SKIRT-E ROOF POLYGON SKIRT-EP X 0 Y 0 Z 0 AZ 0 TILT 0 .. \n")
printf("SKIRT-WP POLYGON (0,%d) (0,%d) (%d,%d) (%d,%d) (0,%d) (0,%d)\n",r,rflgth/2,-rflgth/2,rflgth/2,-
rflgth/2,-rflgth/2,-rflgth/2,-r)
for (k=halfarc;k<=arcs;k++)
  {
   rowx[1,k] = r*sin(ang1*k*angle)
   rowy[1,k] = r*cos(ang1*k*angle)
   l = k-1
   if (l%5 == 0) printf "\n  "
   printf("(%1.2f,%1.2f) ",rowx[1,k],rowy[1,k])
   if (k== arcs) printf " .. \n"
  }
printf("SKIRT-W ROOF POLYGON SKIRT-WP X 0 Y 0 Z 0 AZ 0 TILT 0 .. \n")
print "END .."
print "STOP .."
}
```

DrawBDL 3.0: New and Improved!

Joe Huang and Associates is pleased to announce Version 3.0 of the *DrawBDL* program for viewing the building geometry in DOE-2 input and output files. We have completely rewritten *DrawBDL* using C++ to run in a native 32 bit environment such as Windows 95/2000/NT. In addition to having a somewhat different look and feel, Version 3.0 has the following improvements:

1. New user interface with a hierarchical tree showing all building surfaces.
2. No limit on the number of building surfaces, except for the amount of memory available on the computer.
3. For building surfaces, the expanded data window shows not only the input values, but also their locations in the global coordinate system; for spaces, the data window shows the gross and net areas of walls, windows, doors, roofs, and skylights.
4. Displays surfaces input as two-dimensional or three-dimensional polygons (please see DOE-2.1E Documentation Update #2 http://SimulationResearch.lbl.gov/dirsoft/21e_update2.pdf for the syntax to input surfaces as polygons).



DrawBDL 3.0

5. Changing the sort order of building surfaces used in the display; this allows users to "touch up" the shaded drawings for use in presentations.
6. Output the surface data in *EnergyPlus* *.idf format. This is helpful for *DrawBDL* users who wish to convert their DOE-2 input files into *EnergyPlus* input files. Since *DrawBDL* reads and stores only building surface data, the converted *EnergyPlus* file is a partial file containing only the inputs for building surfaces.

The price for *DrawBDL 3.0* is $125 plus shipping. For more information or to order, please contact

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FREE Membership in 2002!!!

International Building Performance Simulation Association USA Affiliate

The IBPSA-USA Board of Directors has waived the annual membership fee for 2002 so joining our organization is easier than ever. If you want to become a member, send an email with your name, company, mailing and email address, and phone and fax numbers to Rick Strand (r-strand@uiuc.edu). You will receive a confirmation email to indicate that you have been accepted for membership.

www.ibpsa.org

EnergyPlus Weather Data

The EnergyPlus development team is pleased to announce that our web site now offers more than 570 weather locations available for download and ready to use with EnergyPlus. There are 275 locations in the United States, 16 California thermal zones, 55 Canadian locations, and 233 international locations in more than 80 countries.

Go to www.energyplus.gov

On the right side, under Weather Data, click on one of the following links: USA, California, Canada or International.

We recommend that you also download the weather utility RPT file for each location. The RPT file includes design data where available, statistics for the weather file, including typical and extreme periods (hottest summer week, coldest winter week, typical spring week, etc), Koppen climate classification, heating and cooling degree days, monthly average minimum and maximum dry bulb and dew point temperatures, undisturbed ground temperatures, direct and diffuse solar radiation, relative humidity, and wind speed and direction.

GenOpt 1.1.2

Generic Optimization Program

GenOpt *is a multi-parameter optimization program; it automatically finds the values of user-selected design parameters that minimize a cost function, such as annual energy use, calculated by an external simulation program like EnergyPlus, SPARK, DOE-2, BLAST, TRACE, TRNSYS, etc.*

GenOpt *can be used with any simulation program that has text-based input and output. It also offers an interface for adding custom optimization algorithms to its library.*

Release of GenOpt 1.1.2

GenOpt 1.1.2 fixes problems in reading simulation output files where the objective function value is followed by a comma. Such output strings can be found, for example, in some EnergyPlus outputs.

Also, a method called 'postProcessObjectiveFunction(int, double[] f)' has been added to the file named 'Optimizer.java'. You can modify this function to easily implement post-processing of the objective function value, such as adding two outputs to seek the minimum of the sum of the two outputs.

Example files have been added to the ***GenOpt*** web page (http://SimulationResearch.lbl.gov > GenOpt) to help users set up the program to optimize EnergyPlus simulations. ***GenOpt*** input files still have the same syntax as in version 1.1.1. Therefore, your ***GenOpt*** input files are compatible with the new version.

GenOpt 1.1.2 **(with user manual) may be downloaded free of charge from**

http://SimulationResearch.lbl.gov > GenOpt

Building Design Advisor 3.0

Decision making through the integrated use of multiple simulation tools and databases

The **Building Design Advisor (BDA)** is a Windows® program that addresses the needs of building decision-makers from the initial, schematic phases of building design through the detailed specification of building components and systems. The BDA is built around an object-oriented representation of the building and its context, which is mapped onto the corresponding representations of multiple tools and databases. It then acts as a ***data manager*** and ***process controller***, automatically preparing input to simulation tools and integrating their output in ways that support multi-criterion decision-making. BDA 3.0 includes links to **SGE** (a grapical editor for schematic design), **DElight** (a daylighting simulation tool), **ECM** (a simplified electric lighting simulation tool) and the **DOE-2.1E** building energy simulation program.

ECM, an **electric lighting simulation tool**, is integrated through BDA with DOE-2. BDA's Schematic Graphic Editor (**SGE**) allows placement of electric lighting luminaires and specification of reference points for daylight-based electric lighting controls. Moreover, BDA has the capability of **running DOE-2 parametrically** to generate a plot that shows the relationship between effective aperture and energy requirements. There is also the added functionality of working with either **English units or Metric units**.

Current development efforts are focused on the completion of BDA 3.1, which includes computation of operating energy costs. To download a free copy of BDA 3.0, go to

http://gaia.lbl.gov/BDA/index.html

The BDA source code is available for licensing; if interested, please contact Dr. Papamichael at K_Papamichael@lbl.gov.

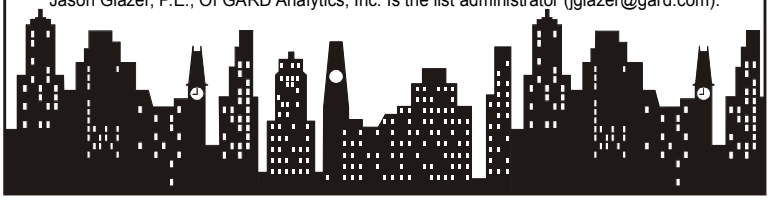
For Beta Testing of BDA 3.1, contact Kosta Papamichael at k_papamichael@lbl.gov.

Join the BLDG-SIM Mailing List

BLDG-SIM is a mailing list for users of building energy simulation programs like EnergyPlus, DOE-2, Trace-600, HAP, BLAST, ESP, SERIRES, TRNSYS, TASE, ENERGY-10 and others. Because building simulation professionals are located worldwide, the BLDG-SIM list is an attempt to foster the development of a community of those users. Users of all levels of expertise are welcome and are encouraged to share their questions and insights about these programs.

The web page for BLDG-SIM is http://www.gard.com/bldg-sim.htm

Jason Glazer, P.E., Of GARD Analytics, Inc. Is the list administrator (jglazer@gard.com).



DoeRayMe

You are invited to test **DoeRayMe**, a new DOE-2.1E screening tool application currently being developed by Jason Glazer, P. E., of GARD Analytics, Inc. **DoeRayMe** is a simple and flexible interface that uses a specially developed DOE-2 input file (template) that contains special codes describing the parameters available to be changed in the user interface. This allows new screening tools to be developed by any DOE-2 user. Please visit the **DoeRayMe** web site at http://www.gard.com/DoeRayMe.

ENERGY-10, VERSION 1.5

ENERGY-10 is a design tool for smaller residential or commercial buildings that are less than 10,000 ft^2 or buildings that can be treated as 1- or 2-zone increments. It performs whole-building energy analysis for 8760 hours/year, including dynamic thermal and daylighting calculations. ENERGY-10 was specifically designed to facilitate the evaluation of energy-efficient building features in the very early stages of the design process.

Version 1.5 Upgrades

Life Cycle Costs

A whole new capability is included to evaluate life-cycle costs. The year-by-year cash flow of the building is determined and discounted to the present value. The difference between Bldg-1 and Bldg-2 is determined in terms of net present value, NPV (the difference in life-cycle costs), internal rate of return, benefit-to cost ratio, or simple payback.

Up-to-date compiler

The entire program has been ported to 32-bit and (with the exception of the CNE thermal simulation engine) programmed in Visual C++ 6.0, the current Microsoft compiler. One benefit that users will appreciate is that it is no longer necessary to close ENERGY-10 before starting a new project.

More Wall Layers

In previous versions, you were restricted to 6 layers in a wall construction. This has now been expanded by 3, giving you the opportunity to define a 7-layer wall plus two air films.

New Graphs

Graphs are programmed in a new and powerful graphing package (Olectra).

New Reports

A Cost Summary report tabulates the results of the life cycle cost evaluation. An HVAC and EES Cost report details the components of HVAC cost and each of the EES costs. A Peak Loads report identifies the peak loads and corresponding HVAC rated capacities for the AutoSize calculations and also the peak loads and consumptions during the annual simulation showing when the peaks occurred.

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Sustainable Buildings Industry Council (SBIC)

ENERGY-10 User Group at http://www.sbicouncil.org/forum

SBIC Bookstore at http://www.sbicouncil.org/store/resources.php#pubs